SOUTHEAST ASIAN LINGUISTICS SOCIETY SEALS

*Journal of the Southeast Asian Linguistics Society*
*JSEALS Vol. 11.1 (2018): 35-46*
*ISSN: 1836-6821, DOI: http://hdl.handle.net/10524/52419*
*University of Hawai'i Press*

# NASAL SUBSTITUTION AND THE LIMITED ROLE OF *NC̥ IN MALAY DIALECTS

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## Abstract

This paper discusses the phonological restriction placed on voiceless obstruents following a nasal segment. It has previously been claimed by Malay scholars that such clusters are not permitted to take place in the surface representation in the Malay language. Therefore, nasal substitution is applied to the clusters to prevent them from occurring at the surface level. This does not, however, apply to the clusters that occur root-internally. The discussion of the phonological issue in this analysis is based on the data of three selected dialects of Malay, namely, Perak, Kelantan and Negeri Sembilan. The data reveals that nasal and voiceless obstruent clusters occurring root-internally might undergo a repair strategy, namely, nasal deletion, this means that segments in roots are not fully preserved as previously claimed. Also, the data from these dialects prove that voiced obstruents following a nasal segment at prefix boundaries may also undergo nasal substitution as voiceless obstruents do. The presence of nasal substitution in nasal-plus-voiced obstruent clusters, in particular, shows the limited role played by *NC̥ as it only allows voiceless obstruents to undergo nasal substitution. Hence, it is proposed that the Optimality Theory constraint CRISP-EDGE[σ] plays a role in accounting for both voiced and voiceless obstruent nasal substitution.

**Keywords:** nasal substitution, *NC̥, Malay dialects, Optimality theory
**ISO 639-3 codes:** msa

## 1. Introduction

It has been widely claimed in relevant literature that a sequence of nasal segments and voiceless obstruents are not allowed to emerge at surface representation. In order to avoid this sequence, a number of phonological processes are applied, such as nasal assimilation, nasal substitution, nasal deletion, denasalisation, post-nasal voicing and epenthesis. The application of these phonological processes depends on the language. That is, not all languages make use of nasal deletion to avoid such clusters. For instance, denasalisation is applied in Mandar, a language spoken in South Sulawesi, where the nasal segment is denasalised as in the word /maN+tunu/, which is realized as [mattunu] 'to burn', while other language such as Indonesian apply nasal substitution to break up a sequence of nasal and voiceless obstruents, as in /məN+sapu/ →[məɲapu] 'to sweep' (Pater, 1999). A language may also have one or more phonological processes as a strategy to get round these clusters. This can be seen, for example, in Kelantan Malay, spoken in Malaysia. Nasal and voiceless obstruent clusters in this language are not resolved by nasal substitution as applied in standard Malay (henceforth SM), for example in /məŋ+tolaʔ/ → [mənolaʔ]. The clusters are resolved by another phonological process, for example, nasalization, as in /ŋ-toloŋ/ → [nnũloŋ].

This phonological restriction is not put on a voiceless obstruent following a nasal segment but a voiced obstruent. Why is that? It has long been observed that, phonetically, a voiceless obstruent following a nasal segment tends to cause difficulty for the articulatory system. As Huffman (1993: 310) observes, the velum rises very gradually during a voiced stop after a nasal segment because the nasal airflow will return to a value typical for plain obstruents during the release phase (cited in Pater, 1999). She further claims that the velum rises more leisurely for nasal and voiced obstruents than for nasal and voiceless obstruents, where the velum needs to be raised quickly to produce a voiceless obstruent following a nasal segment. From this phonetic perspective, it seems that the two segments, i.e. nasal and voiceless obstruent segments, are not able to emerge together. Therefore, they have to undergo some repair strategies to eliminate these clusters. This phonetic justification also explains why the production of a voiced obstruent following a nasal segment does not cause any difficulty to the articulatory system. This is why voiced obstruents are allowed to emerge with nasal segments as they are phonetically compatible with each other and thus no repair strategy needs to be applied.

Since the difficulties are caused by the human articulatory system when a voiceless obstruent is produced after a nasal segment, the presence of these two adjacent segments is effectively banned in many languages of the world, such as Indonesian (Pater, 1999), Toba Batak (Hayes, 1986), Kaingang (Henry, 1948; cf. Piggot, 1995), Chamorro (Topping, 1973, 50), Javanese (Poedjosoedarmo, 1982, 51), the Bantu languages including Umbundu, Si-Luyana and OshiKwanyama (cited by Pater, 1999) and Mandar (Mills, 1975). In a constraint-based approach, the phonological restriction which is put on a voiceless obstruent following a nasal segment is handled by a markedness constraint called *NÇ̥, which ensures that no voiceless obstruent follows a nasal in the surface representation. This means that *NÇ̥ is a driving force for the underlying phonological processes such as nasal substitution, nasal deletion, epenthesis and post-nasal voicing, all of which are applied to eliminate these clusters by ranking the constraints related to these phonological processes above an anti-nasal substitution constraint, called UNIFORMITY, also known as a faithfulness constraint.

It is different from *NÇ̥, which is ranked beneath a faithfulness constraint when a sequence of nasal-plus-voiceless obstruents is produced instead. It has previously been discussed that this type of ranking order, Faithfulness >>*NÇ̥, applies when clusters are within the roots, whereby a root-faithfulness constraint is ranked above *NÇ̥, as they are permitted to emerge in this morphological domain (see Pater, 2001). As exemplified in Pater (1999), words such as /əmpat/ 'four', /untuk/ 'for' and /muŋkin/ 'possible' in Malay are realized as [əmpat], [untuk] and [muŋkin], respectively. It is important to highlight here that nasal-plus-voiceless obstruent clusters occurring root-internally in Malay do not always remain as they are, which means that the clusters somehow undergo some repair strategies such as nasal deletion, as occurs in Kelantan and Negeri Sembilan (henceforth, NS) dialects of Malay, for example /bantal/ 'pillow', /tampar/ 'slap' and /simpan/ 'to keep', realized as [bata:], [tapa:] and [sipan]. The phonological processes which are applied root-internally in Kelantan and Negeri Sembilan dialects of Malay have not attracted much theoretical attention. The issue concerning the non-preservation of root-internal segments will thus be accounted for in this paper as it poses an interesting challenge to phonological theory, such as OT, when a root-specific faithfulness constraint such as UNIFORMITY-ROOT seems no longer plays its important role in preserving the segments in roots.

This paper highlights two issues which deserve investigation since they have been omitted from previous studies. The first issue that will be discussed in this paper is *NÇ̥, which is adopted as one of the solutions for nasal substitution. Does this mean that only a voiceless obstruent can undergo nasal substitution and a voiced obstruent cannot, as it is phonetically compatible with a nasal segment and can emerge with it? Data from two Malay dialects, Perak and NS, present what seems to be a challenge to *NÇ̥ analysis, namely, why nasal-plus-voiced obstruent clusters have to undergo nasal substitution although they are allowed to emerge together. The second issue concerns nasal-plus-voiceless obstruent clusters occurring root-internally. As mentioned above, data from Kelantan and NS reveal that these clusters can also undergo repair strategies. The examples from these dialects appear to be evidence that the clusters are not blocked from undergoing any repair strategies, as previously discussed. The segments within the root are not always faithful, as claimed in previous scholars' works.

## 2. Materials and Methods

Analysis of nasal substitution of the three selected dialects of Malay is based on two types of data: (1) secondary data from previous studies and (2) data from interviews. In order to analyse the issues involved in the three selected Malay dialects, a number of previous works are referred to. Work by Ahmad (1991) is used to analyse the phenomenon of nasal substitution in the Perak dialect. For the Kelantan dialect of Malay, Che Kob's (1985) and Teoh's (1994) studies are referred to, and Hendon's work (1966) is referred to in analyzing the phenomenon of the NS dialect. It should be noted that some of these previous studies do not focus much on the theoretical aspects of the phonological behaviour of the dialects they examined, particularly the work of Che Kob (1985). As far as Kelantan dialect is concerned, Che Kob's work can be considered the one in which the most intensive research has been carried out so far. However, the discussion does not focus on the phonological aspects of the dialect. Rather, it is more of a dialectological study. Data which are relevant to the present study are taken from those scholars' works. The data obtained from Che Kob's is, however, inadequate for the analysis of the three dialects. Hence, interviews were conducted to get more data on the dialects. A short word list was prepared before conducting the interviews. In the interviews, speakers were asked to pronounce the selected words.

Data obtained from previous work and interview sessions were assembled based on the morphological domains to which the words belong, namely, where nasal-plus-voiceless/voiced obstruent clusters emerged in the words. There are three groups: (a) nasal and voiceless obstruents occurring root-internally, (b) nasal and voiceless obstruent sequences at prefix-root junctures and (c) nasal and voiced obstruent sequences at prefix-root junctures. Table 1 shows some of the data which represent each of these groups.

***Table 1:*** *Data of nasal and voiceless/voiced obstruents*

*a. Nasal and voiceless obstruents occurring root-internally*

| SM | Perak | Kelantan | NS |
|---|---|---|---|
| kampoŋ | kampoŋ | kapoŋ | kapoŋ |
| sampan | sampan | sapɛ̃ | sapan |
| sampai | sampai | sapɛ | sapa |
| kuntum | kuntum | kutum | kutom |
| kəlantan | kəlantan | kəlatɛ̃ | kəlatan |
| teŋkat | teŋkat | tekaʔ | tekaʔ |
| təmpat | təmpat | təpaʔ | təpa |

*b. Nasal and voiceless obstruent sequences at prefix-root junctures*

| SM | Perak | Kelantan | NS |
|---|---|---|---|
| məmilih | milih | mmile | mmilih |
| məmukul | mukol | mmũkɔ | mmuko |
| mənarik | nareʔ | nnareʔ | mnareʔ |
| məŋətuk | ŋətoʔ | ŋŋətoʔ | mŋotoʔ |
| mənoloŋ | noloŋ | nnuloŋ | mnuloŋ |
| məmikir | mike | mmike | mmikɛ |
| mənukar | nuka | nnũka | mnuka |
| məŋipas | ŋipas | ŋŋipah | ŋipah |

*c. Nasal and voiced obstruent sequences at prefix-root junctures*

| Sz | Perak | Kelantan | NS |
|---|---|---|---|
| məmbagi | magi | mmbagi | mmagi |
| məmbasoh | masoh | mmbasoh | mmasoh |
| məmbaca | maca | mmbaca | mmaca |
| məmbunoh | munoh | mmbunoh | mmunoh |
| məndapat | napat | nndapaʔ | mnapeʔ |
| məndukoŋ | nukoŋ | nndukoŋ | mnukoŋ |

As mentioned, the two main issues examined in this study concern, first, the preservation of root-internal segments (that is to what extent segments (nasal and voiceless obstruents) in roots are preserved from undergoing phonological processes which are always applied to avoid clusters) and, second, the application of nasal substitution to a voiceless obstruent following a nasal segment due to a phonological restriction. This paper attempts to examine the application of nasal substitution, particularly when it is actually in operation. Does it only operate when there is a sequence of nasal and voiceless obstruents? These two key issues will be discussed in the following section.

## 3. Results and Discussion

### *3.1 Nasal substitution in other languages*

As mentioned above, the phonological restriction placed on nasal-plus-voiceless obstruent clusters can lead to a number of phonological processes, such as nasal assimilation, vowel epenthesis, nasal substitution, post-nasal voicing and nasal deletion. By applying one of these processes, an output with no nasal and voiceless obstruent clusters is derived, thus satisfying the markedness constraint called *NC̥. The following examples show how those phonological processes are applied in the world's languages.

| | | |
|---|---|---|
| a) post-nasal voicing | /sinik-pa/ 'porcupine's' → [kam-ba] 'yours' | Puyu Pungo Quechua (Orr, 1962; Rice, 1993) |
| b) denasalisation | /maN-tunu/ → [mattunu] 'to burn' | Mandar (Mills, 1975) |
| c) nasal substitution | /e:N-pati/ → [e:mati] 'ribs' | OshiKwanyama (Steinbergs, 1985) |

The phonological processes exemplified above are the result of the NC̥ effects. In order to satisfy the markedness constraint NC̥, it is necessary that the output does not contain any nasal-plus-voiceless obstruent clusters, described in the phonological processes such as nasal deletion, denasalisation, post-nasal voicing and nasal substitution. Markedness constraints require that the output form meet some criterion of structural well-formedness (cf. Kager, 1999). A markedness constraint assigns its violation without any reference to the input, as required in faithfulness constraints. Markedness constraints play a key role as a grammatical factor that produces 'unmarked types of structure'. An unmarked structure is one of the two types of linguistic structures, the other one being a marked structure. Cross-linguistically, an unmarked structure is preferred and it is basis to all grammars, while a marked structure is avoided and only used by grammars to create contrast (cf. Kager, 1999).

However, nasal-plus-voiceless obstruent clusters within the root do not have the same phonological restriction as clusters across the morpheme boundary. In other words, nasal-plus-voiceless obstruent clusters within roots do not undergo any repair strategies to break up the clusters, for example /əmpat/'four' → [əmpat], /untuk/ 'for' → [untuk] and /muŋkin/ 'maybe' → [muŋkin] in Indonesian (Pater, 1999 and 2001). The blocking of nasal substitution within roots in Indonesian has received much attention among theoretical linguists, particularly within OT (for example, Pater, 1999 and 2001). In explaining the lack of nasal substitution at root-internal position, McCarthy and Prince (1994b, cited in Pater, 1996) claim that 'a large number of disparate phonological phenomena for instance, reduplicative and otherwise, result in a stricter faithfulness requirement within the root than elsewhere in the word, that is the relative markedness of roots' (see also Urbanczyk, 1996). In OT, this situation is described as faithfulness requirements being more strictly applied within root than non-root morphemes, such as affixes (McCarthy and Prince, 1995, cited in Kager, 1999: 75). In describing this, McCarthy and Prince (1994a) propose a general ranking schema where root-specific versions of faithfulness constraints are ranked higher than the general version of these constraints: Root-Faithfulness >> Faithfulness.

Pater (1999 and 2001), for example, captures the case of blocking nasal substitution in Indonesian by applying the ideas of McCarthy and Prince (1994a). Two root-specific constraints, LINEARITY-ROOT and UNIFORMITY-ROOT, are used.[1] Tableau 2 and Tableau 3 illustrate how Pater makes use of these two root-specific constraints to analyse the lack of nasal substitution in Indonesian.

***Tableau 2:*** *Root-internal NC̥ tolerance: ROOTLIN >>*NC̥ (adapted from Pater, 1999: 275)*

| /əm$_1$p$_2$at/ | LINEARITY-ROOT | *NC̥ | LINEARITY |
|---|---|---|---|
| a. əm$_{12}$at | *! | | * |
| b.☞əm$_1$p$_2$at | | * | |

1 Pater's analysis concerning nasal substitution in Indonesian applies two constraints: LINEARITY is used in his earlier analysis but UNIFORMITY in the revisited analysis on nasal substitution in Austronesian. According to McCarthy (1995), LINEARITY and UNIFORMITY are used to ban metathesis and coalescence, respectively.

***Tableau 3:** Root-internal NC̥ tolerance: UNIFORMITY-ROOT >>*NC̥ >> UNIFORMITY (adapted from Pater 2001:162)*

| /əm$_1$p$_2$at/ | UNIFORMITY-ROOT | *NC̥ | UNIFORM |
|---|---|---|---|
| a. əm$_{12}$at | *! | | |
| b.☞əm$_1$p$_2$at | | * | * |

Tableau 2 and Tableau 3 clearly show that the root-specific constraints LINEARITY-ROOT and UNIFORMITY-ROOT play important roles in accounting for the blocking of nasal substitution root-internally in Indonesian. According to Pater (2001), by ranking the root-specific constraints UNIFORMITY-ROOT and LINEARITY-ROOT above *NC̥, nasal substitution can certainly be stopped from occurring within roots in Indonesian. To ensure nasal substitution is not blocked at prefix junctures, *NC̥ must outrank UNIFORMITY or LINEARITY, so that nasal substitution will continue to apply, as shown in Tableau 4.

***Tableau 4:** Nasal substitution is not blocked at prefix junctures in Indonesian*

UNIFORMITY-ROOT >> *NC̥ >> UNIFORM (from Pater, 2001:161)

| /məŋ$_1$p$_2$aksa/ | UNIFORMITY-ROOT | *NC̥ | UNIFORM |
|---|---|---|---|
| a.☞məm$_{12}$aksa | | | * |
| b. məm$_1$p$_2$aksa | | *! | |

As can be seen in Tableau 4, nasal substitution continues to apply at prefix junctures by employing the constraint ranking: UNIFORMITY-ROOT >> *NC̥ >> UNIFORM. Since the root-specific constraint is only able to block nasal substitution within a root, this constraint is thus not violated by candidate (a) as it undergoes nasal substitution. This candidate, however, violates UNIFORMITY, since the sequence of nasal and voiceless obstruents at the prefix juncture in the input is substituted with a single segment in the output.

### *3.2 Nasal substitution in Kelantan and NS Malay dialects*

As we shall see, the reverse state of affairs occurs in two of the Malay dialects discussed in this study, namely, Kelantan and NS. Unlike in Indonesian, root-internal nasal and voiceless obstruent clusters in Kelantan and NS dialects undergo nasal deletion, as shown in Table 5.

***Table 5:** Nasal-plus-voiceless obstruent clusters within roots in Kelantan and NS dialects*

| **SM** | **Kelantan** | **NS** | |
|---|---|---|---|
| kampoŋ | kapoŋ | kapoŋ | 'village' |
| sampan | sapɛ̃ | sapan | 'small boat' |
| sampai | sapɛ | sapa | 'arrive' |
| kuntum | kutum | kutom | 'flower bud' |
| kəlantan | kəlatɛ̃ | kəlatan | 'name of state' |
| teŋkat | tekaʔ | tekaʔ | 'level' |
| təmpat | təpaʔ | təpa | 'place' |

The above data show that nasal-plus-voiceless obstruent clusters in the Kelantan and NS dialects of Malay undergo nasal deletion. Since the clusters in both dialects undergo nasal deletion, a root-specific faithfulness constraint such as UNIFORMITY-ROOT, which has been claimed must be ranked above a markedness constraint, *NC̥. However, it certainly does not work for Indonesian. If UNIFORMITY-ROOT were to be ranked above *NC̥ to account for the above data, then the incorrect output would be derived instead, and the nasal segment would remain undeleted. The application of nasal deletion results in one segment of the input not being preserved in the output. Hence, in this case, a stricter faithfulness requirement within the roots than elsewhere in the words, as claimed by previous scholars (for examples, McCarthy and Prince, 1995; Urbanczyk, 1996), is questionable. Given the data from the Kelantan and NS dialects of Malay presented above, one might ask how faithful segments in roots should be, since there are examples confirming that segments in roots can also undergo phonological processes such as nasal deletion, which means that the preservation of segments within the roots is not that strict. Thus, to account for this, a root-specific faithfulness constraint is ranked beneath rather than above *NC̥. The analysis in Tableau 6, here for the Kelantan dialect, demonstrates how this ranking, that is *NC̥ >> UNIFORMITY-ROOT, applies.

***Tableau 6:*** *DEP-IO >> *NC̥ >> UNIFORMITY-ROOT >> UNIFORMITY >> MAX-IO*

| /gan$_1$t$_2$oŋ/ | DEP-IO | *NC̥ | UNIFORMITY-ROOT | UNIFORMITY | MAX IO |
|---|---|---|---|---|---|
| a.☞gat$_2$oŋ | | | * | | * |
| b. gan$_1$ət$_2$oŋ | *! | | | | |
| c. gan$_1$t$_2$oŋ | | *! | | | |

By ranking the markedness constraint *NC̥ above the faithfulness constraint UNIFORMITY-ROOT, the desired output is derived. Since *NC̥ is ranked above UNIFORMITY-ROOT, candidate (c) with a sequence of nasal-plus-voiceless obstruents is not the ideal candidate. If the ranking UNIFORMITY-ROOT >> *NC̥ were to apply in the Kelantan dialect to account for nasal deletion in root-internal position, incorrect output *[gantoŋ] would follow, as demonstrated in Tableau 7.

***Tableau 7:*** *DEP-IO >> UNIFORMITY-ROOT >> *NC̥ >> UNIFORMITY >> MAX-IO*

| /gan$_1$t$_2$oŋ/ | DEP-IO | UNIFORMITY -ROOT | *NC̥ | UNIFORMITY | MAX IO |
|---|---|---|---|---|---|
| a. ☹gat$_2$oŋ | | *! | | | * |
| b. gan$_1$ət$_2$oŋ | *! | | | | |
| c. ☞gan$_1$t$_2$oŋ | | | * | | |

Let us now proceed to the second issue of this study, specifically voiced obstruent nasal substitution. As been claimed long before, a voiced obstruent following a nasal segment is prevented from undergoing any repair strategy as the clusters do not cause any difficulty to the articulatory system when they are pronounced. It ought to be mentioned that a voiced obstruent after a nasal segment, as seen in some Malay dialects i.e. Perak and NS, results in examples that contradict the claim made earlier. As shown in the previous section, voiced obstruents at prefix-root boundaries in the Perak and NS dialects of Malay also undergo nasal substitution, similar to voiceless obstruents.

***Table 8:*** *Nasal and voiceless obstruent sequences at prefix-root junctures*

| **Root** | **SM** | **Perak** | **NS** |
|---|---|---|---|
| pilih ‘to choose’ | məmilih | milih | Mmilih |
| pukul ‘to scold’ | məmukul | mukol | Mmuko |
| tarik ‘to pull’ | mənarik | nareʔ | mnareʔ |
| kətuk ‘to knock’ | məŋətuk | ŋətoʔ | mŋotoʔ |
| toloŋ ‘to help’ | mənoloŋ | noloŋ | Mnuloŋ |
| fikir ‘to think’ | məmikir | mike | Mmikɛ |
| tukar ‘to change’ | mənukar | nuka | Mnuka |
| kipas ‘fan’ | məŋipas | ŋipas | Ŋipah |

***Table 9:*** *Nasal and voiced obstruent sequences at prefix-root junctures*

| **Root** | **SM** | **Perak** | **NS** |
|---|---|---|---|
| bagi ‘to give’ | məmbagi | Magi | Mmagi |
| basuh ‘to wash’ | məmbasoh | masoh | mmasoh |
| baca ‘to read’ | məmbaca | Maca | Mmaca |
| bunuh ‘to kill’ | məmbunoh | munoh | mmunoh |
| dapat ‘to get’ | məndapat | Napat | mnapeʔ |
| dukuŋ ‘to carry’ | məndukoŋ | nukoŋ | mnukoŋ |

The above data reveal that both voiceless and voiced obstruents after a nasal segment undergoes substitution. As mentioned earlier, nasal substitution is applied to break up a sequence of nasal and voiceless obstruent clusters due to phonetic incompatibility of the two segments emerging together. The production of a voiceless obstruent after a nasal segment needs the velum to be raised more quickly than usual. Hence there is difficulty in producing it. To overcome this difficulty with the production of a voiceless obstruent after a nasal segment, some repair strategies need to be undertaken. In phonology, this problem is resolved by the requirement of obeying a constraint called *NC̥. This obedience to *NC̥ causes a word such as /məŋ+paksa/, ‘to force’, to surface as [məm$_{12}$aksa], where the cluster undergoes nasal substitution.

In contrast to a voiceless obstruent, a voiced obstruent after a nasal segment does not need to undergo a nasal substitution. Why does a sequence of nasal and voiced obstruents not need to undergo a nasal substitution? It is because this sequence allows a more leisurely raising of the velum than with nasal and voiceless obstruents (Huffman, 1993: 310, cited in Pater, 1999). Thus, there is no need for a voiced obstruent following a nasal segment to undergo a nasal substitution. Some dialects of Malay, however, demonstrate that a voiced obstruent following a nasal segment will also undergo a nasal substitution. Phonetically, it raises the question of why an initial voiced obstruent in the Perak and NS dialects of Malay needs to be substituted, since it is allowed to emerge together with a nasal segment and the language does license nasal-voiced obstruent clusters in a word. What argument can OT offer to explain the phenomenon of substituting a voiced obstruent following a nasal segment? Before returning to the analysis of voiced and voiceless obstruents undergoing nasal substitution in the two dialects of Malay considered in this study, it is worth reflecting on what has been done previously.

In Pater’s (2001) analysis of Austronesian nasal substitution, he shows that by ranking IDENT [PHAREXP] (as defined in (10) below) above the constraint called CRISP-EDGE [PrWD] requires no element belonging to a prosodic word is linked to a prosodic category external to that prosodic word (Pater, 2001), as defined in (11), a voiced obstruent can be prevented from undergoing nasal substitution.

*(10)* ***IDENT [PHAREXP]*** *(Pater 2001)*

Correspondent segments have identical values for the feature [PHAREXP]. If αRβ and α is [γ PHAREXP], then β is [γ PHAREXP].

*(11)* ***CRISP-EDGE [PrWD]*** *(adapted from Pater 2001)*

No element belonging to a prosodic word may be linked to a prosodic category external to that prosodic word.

Tableaux 10 demonstrate how this ranking, i.e. IDENT [PHAREXP] >> CRISP-EDGE[PrWD], blocks a voiced obstruent from undergoing nasal substitution, but not a voiceless obstruent.

***Tableaux 10:*** *IDENT [PHAREXP] >> CRISP-EDGE [PrWD] (Pater, 2001:176)*

| /məŋ$_1$+b$_2$əli/ | IDENT[PHAREXP] | CRISP-EDGE[PrWD] |
|---|---|---|
| a.☞məm$_1$b$_2$əli | | * |
| b. məm$_{12}$əli | *! | |
| /məŋ$_1$+p$_2$ilih/ | | |
| c.☞məm$_{12}$ilih | * | |
| d. məm$_1$p$_2$ilih | | *! |

It can be seen in Tableaux 10 that a voiced obstruent following a nasal segment can be blocked from undergoing a nasal substitution by the constraint ranking IDENT [PHAREXP] >> CRISP-EDGE [PrWD]. However, with the ranking reversed, i.e. CRISP-EDGE [PrWD] >> IDENT [PHAREXP], both voiceless and voiced obstruents are subject to fusion (Pater 2001,176), as Tableaux 11 demonstrate.

***Tableaux 11:*** *CRISP-EDGE [σ] >> IDENT [PHAREXP] (Pater 2001:176)*

| $/N_1+B_2/$ | CRISP-EDGE[PrWD] | IDENT[PHAREXP] |
|---|---|---|
| a.☞$M_{12}$ | | * |
| b. $M_1B_2$ | *! | |
| $/N_1+P_2/$ | | |
| c.☞$M_{12}$ | | |
| d. $M_1P_2$ | *! | |

Considering the ranking CRISP-EDGE[PrWD] >> IDENT[PHAREXP], as in the above tableaux, a voiced as well as a voiceless obstruent following a nasal segment at a prefix-root juncture can also undergo nasal substitution.

To account for the case in Perak and NS dialects, nasal substitution with voiced obstruents can be attributed to the ranking of IDENT [PHAREXP] beneath CRISP-EDGE [PrWD]. Tableau 12 is an example of how a nasal plus a voiced obstruent sequence in Perak undergoes a nasal substitution:

***Tableau 12:*** *Nasal substitution with a voiced obstruent in Perak: CRISP-EDGE [σ] >> IDENT [PHAREXP]*

| /$ŋ_1$+$b_2$agi/ | CRISP-EDGE [PrWD] | IDENT [PHAREXP] |
|---|---|---|
| a.☞$m_{12}$agi | | * |
| b. $m_1b_2$agi | *! | |

The above analysis clearly shows that a sequence of nasal and voiced obstruents in the Perak dialect undergoes nasal substitution. Most previous studies of nasal substitution in Malay (e.g. Hassan, 1974, 1987; Omar, 1975, 1993; Karim, 1995; M.Onn, 1980) and other languages (e.g. Halle & Clement, 1983; Pater, 1999 2001; Blust, 2004) only relate this phonological process to nasal and voiceless obstruent clusters. Therefore, *NC̥ plays an important role in their analysis. The present analysis reveals the limitation of *NC̥ which prohibits nasal and voiceless obstruent sequences, it cannot satisfactorily explain the phenomenon of voiced obstruent nasal substitution. Hence, to offer a better explanation, *NC̥ is replaced by another constraint, CRISP-EDGE [PrWD], which is able to capture the nasal substitution in both voiceless and voiced obstruents.

It has been demonstrated in previous works the importance of *NC̥ constraint in eliminating nasal and voiceless obstruent clusters. In order to satisfy this markedness constraint, the clusters must undergo nasal substitution. It is however difficult to explain the process of nasal substitution with voiced obstruents since it is beyond the limits of *NC̥ to eliminate a sequence of nasal and voiced obstruents. The following tableau demonstrates how difficult it is for *NC̥ to capture voiced obstruent nasal substitution. If *NC̥ were to apply, then the optimal output would fall to candidate (b), which is not the correct output for Perak dialect, as in Tableau 13.

***Tableau 13:*** **NC̥ >> IDENT [PHAREXP]: *[mbagi]*

| /$ŋ_1$+$b_2$agi/ | *NC̥ | IDENT[PHAREXP] |
|---|---|---|
| a. $m_{12}$agi | | *! |
| b.☹$m_1b_2$agi | | |

As can be seen, candidate (a) is ruled out because it violates IDENT [PHAREXP]. Candidate (b), does not violate any constraint in the hierarchy, becomes the winner. Nevertheless, this is incorrect output since a voiced obstruent after a nasal segment in the dialect must undergo nasal substitution. It is clear then that *NC̥ in the above constraint hierarchy does not play a significant role in ruling out a sequence of nasal and voiced obstruents, as displayed in candidate (b), since the constraint applies specifically to nasal and voiceless obstruent clusters. This shows that the constraint *NC̥ cannot be used to account for voiced obstruent nasal substitution as occurs in the Perak dialect above.

Considering all the cases discussed, i.e. nasal deletion which occurs root-internally examined, as well as voiced obstruent nasal substitution at prefix boundaries in the Perak and NS dialects, this study proposes the use of CRISP-EDGE [σ] as a better solution to account for both cases instead of *NC̥ and CRISP-EDGE [PrWD]. This constraint, CRISP-EDGE [σ], can be defined as in (16).

*(16) CRISP-EDGE [σ]*

No element belonging to a syllable may be linked to an adjacent syllable.

*NC̥ is not used as it can only rule out nasal-plus-voiceless obstruent clusters which leads to nasal substitution is unecessary. The use of this constraint, however, cannot be applied to rule out a sequence of nasal-plus-voiced obstruents and yet the output with voiced obstruent nasal substitution could be derived. In contrast to *NC̥, CRISP-EDGE [σ] is able to rule out both voiced and voiceless obstruents following a nasal segment, as the nasal segment and voiceless/ voiced obstruent share the same place of articulation and are thus linked together in the same syllable. The diagrams in 14, 15 and 16 illustrate the violation of CRISP-EDGE [σ] by a voiceless/voiced obstruent following a nasal segment at a prefix boundary, and nasal-plus-voiceless obstruent clusters within the root.

***Diagram 14:*** *CRISP-EDGE [σ] violation: nasal-plus-voiceless obstruent sequence – *[$m_1p_2$udʒi]*

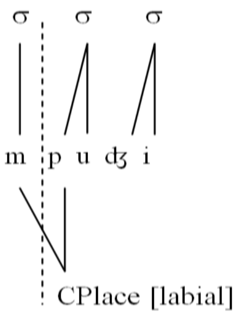



***Diagram 15:*** *CRISP-EDGE [σ] violation: nasal-plus-voiced obstruent sequence – *[mbasoh]*

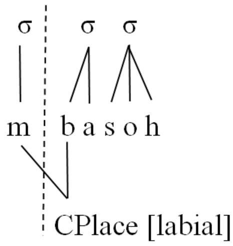
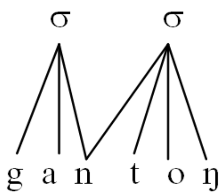



***Diagram 16:*** *CRISP-EDGE [σ] violation:*
*nasal-plus-voiceless obstruent sequence occurring root-internally – /ga$n_1t_2$oŋ/ → *[ga$n_1t_2$oŋ].*




With the use of CRISP-EDGE[σ] over CRISP-EDGE [PrWD] in this analysis, the candidate *[ga$n_1t_2$oŋ] can be ruled out. Therefore, the desired optimal output, [ga$t_2$oŋ], can be obtained. The optimal output, [ga$t_2$oŋ], would, however, be impossible to obtain if the constraint CRISP-EDGE [PrWD] were to be applied, as the sequence of nasal-plus-voiceless plosive alveolar [nt] is not possible in a prosodic word. Bringing all the constraints used earlier together with the new constraint proposed for the analysis of Perak and NS dialects, i.e. CRISP-EDGE[σ], and replacing *NC̥, Tableaux 17 demonstrate how CRISP-EDGE[σ] can perform better than*NC̥.

***Tableaux 17:*** *Ranking for Perak dialect: voiced/ voiceless obstruent nasal substitution at prefix boundaries*

| /ŋ$_1$+p$_2$udʒi/ | NAS ASS | MAX-IO | UNIFORMITY-ROOT | CRISP-EDGE[σ] | UNI |
|---|---|---|---|---|---|
| a. ☞m$_{12}$udʒi | | | | | * |
| b. m$_1$p$_2$udʒi | | | | *! | |
| c. p$_2$udʒi | | *! | | | |
| d. ŋ$_1$p$_2$udʒi | *! | | | | |
| /ŋ$_1$+b$_2$agi/ | | | | | |
| e.☞ m$_{12}$agi | | | | | * |
| f. m$_1$b$_2$agi | | | | *! | |
| g. ŋ$_1$b$_2$agi | *! | | | | |

The above analysis demonstrates how the phonological process, i.e. nasal substitution, applies at prefix boundaries in the Perak dialect, and how the process involves both voiced/ voiceless obstruents following a nasal segment. As illustrated in the above table, candidates (b) and (f) with a voiceless and voiced obstruent after a nasal segment, respectively, are ruled out by CRISP-EDGE[σ] as the two segments (i.e. nasal and voiceless/ voiced obstruents) in these candidates are multiply linked.

Unlike the Perak dialect, the phonological restriction on nasal and voiceless obstruent clusters in the NS dialect is stricter given that the clusters are not even allowed to surface root-internally (see Section 2), or at prefix boundaries. To avoid the occurrence of clusters within the roots, nasal deletion takes place, while nasal substitution continues to be applied to clusters at prefix boundaries. Concerning a voiced obstruent after a nasal segment at a prefix boundary, the NS dialect has the same restriction as the Perak dialect whereby a voiced obstruent following a nasal segment is disfavoured, hence nasal substitution applies. The following tableaux demonstrate all three cases, i.e. nasal-plus-voiceless obstruents within roots, voiced and voiceless obstruents after a nasal segment at prefix boundaries.[2]

***Tableaux 18:*** *Ranking for NS dialect: nasal deletion root-internally and voiced/voiceless obstruent nasal substitution at prefix boundaries*

| /dan$_1$t$_2$um/ | CRISP-EDGE[σ] | NAS ASS | UNIFORMITY-ROOT | MAX-IO | UNI |
|---|---|---|---|---|---|
| a. dan$_1$t$_2$um | *! | | | | |
| b.☞dat$_2$um | | | | * | |
| c. dan$_{12}$um | | | *! | | |
| /mŏN$_1$+p$_2$ilih/ | | | | | |
| d. mŏN$_1$p$_2$ilih | | *! | | | |
| e.☞mŏm$_{12}$ilih | | | | | * |
| f. mŏm$_1$p$_2$ilih | *! | | | | |
| g. mŏp$_2$ilih | | | | *! | |
| /mŏN$_1$+b$_2$aco/ | | | | | |
| h. mŏN$_1$b$_2$aco | | *! | | | |
| i. mŏm$_1$b$_2$aco | *! | | | | |
| j.☞mŏm$_{12}$aco | | | | | |

## 4. Conclusion

It is evident from the above discussion that nasal-plus-voiceless obstruent clusters in Malay dialects are not fully preserved root-internally, as claimed by previous studies. As was proven in the analysis, segments within a morpheme are not well preserved and not prevented from undergoing any phonological process. As

[2] It should be noted that the nasal final prefix /mŏN+/ used in the NS dialect is the same as /N+/ or /məŋ+/ as used in linear and non-linear phonology approaches, respectively, in standard Malay and some of its dialects. Some dialects of Malay only have /ŋ+/ as their prefix. Whatever it is, all forms have the same syntactic meaning in the language, i.e. active verb form.

seen in two Malay dialects namely, Kelantan and NS, nasal-plus-voiceless obstruent clusters still have to undergo repair strategies in order to prevent the clusters from emerging at the surface representation. It can be claimed that these dialects are likely satisfying the unmarked form, rather than the preserving segments. Moreover, the occurrence of a voiced obstruent after a nasal segment in Perak and NS dialects has given rise to an interesting phonological discussion as the clusters also have to undergo nasal substitution as applied to voiceless obstruents. Such examples from the dialects discussed in this analysis can be valuable phonological evidence that demonstrates how nasal substitution can be applied to clusters that phonetically are allowed to emerge. To sum up, based on discussion above, it can be claimed that the constraint *NC̥, which is used to eliminate nasal and voiceless obstruent clusters that lead to the application of nasal substitution, plays a limited role. By replacing this constraint by CRISP-EDGE[σ], nasal substitution does not only apply to a voiceless obstruent following a nasal segment, but also to a voiced obstruent.

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**Reviewed**: Received 3 November 2016, revised text accepted 8 January 2018, published 22 February 2018
**Editors**: Editor-In-Chief Dr Mark Alves | Managing Eds. Dr Paul Sidwell, Dr Nathan Hill, Dr Sigrid Lew